

AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A network system including comprising:
a plurality of paths; and
at least one cache server, the at least one cache server comprising:
a quality-of-service (QoS) path information obtaining section for obtaining
QoS path information including network path information and path load information,
a path calculating section for identifying a candidate path suitable for
carrying out at least one of an automatic cache updating operation, a link prefetching
operation, and a cache server cooperating operation, based on the QoS path
information obtained by the QoS path information obtaining section, wherein the path
calculating section identifies the candidate path as having a maximum remaining
bandwidth of the plurality of the paths and identifies a link on the candidate path that
has a minimum remaining bandwidth, and
at least one of an automatic cache updating section, a link prefetching
control section, and a cache server cooperating section, which carry out respective
ones of the automatic cache updating operation, the link prefetching operation, and the
cache server cooperating operation by using the candidate path identified by the path
calculating section when the minimum remaining bandwidth is not smaller than a
predetermined value.
2. (Canceled)
3. (Original) The network system according to claim 1, further comprising:
a router on which a path control protocol operates to exchange network
path information and path load information,
wherein the QoS path information obtaining section obtains the network
path information and the path load information in cooperation with the router.

4. (Previously Presented) A network system having a plurality of paths, the network system comprising:

a plurality of path-settable routers, each of which allows a requested path to be set up on a network; and

at least one cache server, the at least one cache server comprising:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information,

a path calculating section for obtaining a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies the candidate path as having a maximum remaining bandwidth of the plurality of the paths, identifies a link on the candidate path having a minimum remaining bandwidth and determines whether the minimum remaining bandwidth is not smaller than a predetermined value, and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which request at least one of the path-settable routers to set the candidate path obtained by the path calculating section and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by using the candidate path set by said at least one of the path-settable routers.

5. (Canceled)

6. (Original) The network system according to claim 4, wherein each of the path-settable routers operates a path control protocol to exchange network path information and path load information, and

the QoS path information obtaining section obtains the network path information and the path load information in cooperation with at least one of the path-settable routers.

7. (Previously Presented) A network system comprising:
a plurality of routers;
at least one cache server; and
at least one relay server,
wherein each of the routers operates a path control protocol to exchange network path information and path load information,
wherein the at least one cache server comprising:
a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the routers, and
a relay control section for selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for instructing the selected at least one relay server about data to be relayed, wherein the relay control section selects the at least one relay server needed for setting a relay path on which there exists no congestion portion, and when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the relay server near to the congestion portion stores the data and, when the congestion has been relieved, transfers the data to downstream, and
wherein the at least one relay server relays the data according to an instruction from the relay control section.

8. (Canceled)

9. (Canceled)
10. (Previously Presented) A network system comprising:
 - a plurality of routers;
 - at least one cache server; and
 - at least one relay server,wherein each of the routers operates a path control protocol to exchange network path information and path load information,
 - wherein the at least one cache server comprises:
 - a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the routers, and
 - a relay control section for selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section selecting the path as having a maximum remaining bandwidth of a plurality of paths by identifying a link on the selected path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further and for instructing the selected at least one relay server about data to be relayed and to relay the data using the selected path, the at least one relay server relaying the data according to an instruction from the relay control section.
11. (Previously Presented) A network system comprising:
 - a plurality of path-settable routers;
 - at least one cache server; and
 - at least one relay server,

wherein each of the path-settable routers operates a path control protocol to exchange network path information and path load information and is allowed a requested path to be set on a network,

wherein said at least one cache server comprises:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the path-settable routers,

a relay control section for selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for instructing the selected at least one relay server about data to be relayed, wherein the relay control section selects the at least one relay server needed for setting a relay path on which there exists no congestion portion, and wherein, when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the relay server near to the congestion portion stores the data and, when the congestion has been relieved, transfers the data to downstream, and

a path setting section for requesting the selected at least one relay server to relay the data using the selected path, wherein said at least one relay server relays the data according to an instruction from the relay control section.

12.-27. (Canceled)

28. (Previously Presented) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a path calculating section for identifying a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the path calculating section identifying the candidate path having a maximum remaining bandwidth of a plurality of paths and determining a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by utilizing the candidate path identified by the path calculating section.

29. (Previously Presented) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a path calculating section for identifying a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the path calculating section identifying the candidate path having a maximum remaining bandwidth of the plurality of the paths and determining a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section that requests the path-settable router to set the path obtained by the path calculating section, and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by utilizing the candidate path set by the path-settable router.

30. (Previously Presented) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information; and

a relay control section for selecting a relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying a candidate path having a maximum remaining bandwidth of a plurality of paths and identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further for instructing the selected relay server about data to be relayed.

31. (Previously Presented) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a relay control section for selecting a candidate path and a relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying the candidate path having a maximum remaining bandwidth of a plurality of paths and identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further for instructing the selected relay server about data to be relayed; and

a path setting section for requesting said at least one path-settable router to set the candidate path selected by the relay control section.

32.-34. (Canceled)

35. (Previously Presented) A relay server for relaying data necessary for at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, according to an instruction received from a relay control section provided in a cache server, wherein the relay server identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value.

36. (Original) The relay server according to claim 35, wherein the relay server relays data for each content.

37. (Previously Presented) A router provided on a network, comprising:
a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information; and

a relay control section for selecting a router having a relay function suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for notifying the selected router of data to be relayed, wherein the relay control section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value, and

wherein the QoS path information obtaining section and the relay control section are provided within a housing of the router, wherein the router relays the data according to an instruction received from a relay control section within another router.

38. (Previously Presented) A router provided on a network, allowing a requested path to be set on the network, the router comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a relay control section for selecting a candidate path and a router having a relay function suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value, and the relay control section for notifying a selected relay server of data to be relayed; and

a path setting section for requesting the router to set the candidate path identified by the relay control section,

wherein the QoS path information obtaining section, the relay control section and the path setting section are provided within a housing of the router, wherein the router relays the data according to an instruction received from a relay control section within another router.

39. (Previously Presented) A cache server controlling method comprising:
a) obtaining QoS path information that includes network path information and path load information;

b) obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a) and by

b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

b2) identifying a link on the candidate path having a minimum remaining bandwidth, and

b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

c) providing at least one of an automatic cache updating step, a link prefetching control step, and a cache server cooperating step, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path obtained at the step (b).

40. (Previously Presented) A cache server controlling method comprising:
a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

b) obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a) by

b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

b2) identifying a link on the candidate path having a minimum remaining bandwidth, and

b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value;

c) requesting at least one path-settable router to set the path obtained by the step (b); and

d) providing at least one of an automatic cache updating step, a link prefetching control step, and a cache server cooperating step, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path set by said at least one path-settable router.

41. (Previously Presented) A cache server controlling method comprising:

a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information;

b) selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a)

c) obtaining a path suitable for carrying out the at least one of an automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by

- c1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,
- c2) identifying a link on the candidate path having a minimum remaining bandwidth, and
- c3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and
- d) instructing said at least one selected relay server about data to be relayed.

42. (Previously Presented) A cache server controlling method comprising:

- a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;
- b) selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the QoS path information obtaining step, and instructing said at least one selected relay server about data to be relayed, wherein the step of selecting the path further comprises
 - b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,
 - b2) identifying a link on the candidate path having a minimum remaining bandwidth, and
 - b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and
- c) requesting said at least one path-settable router to set the path selected at the step (b).

43. (Canceled)

44. (Canceled)

45. (Currently Amended) A recording medium storing a program for instructing a computer to function as:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information;

a path calculating section for ~~obtaining~~ obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation by using the path obtained by the path calculating section.

46. (Previously Presented) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a path calculating section for obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which request the path-settable router to set the path obtained by the path calculating section, and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path set by the path-settable router.

47. (Canceled)

48. (Previously Presented) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information; and

a relay control section for selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and instructing said at least one relay server about data to be relayed, the relay control section further selecting a candidate path having a maximum remaining bandwidth of a plurality of paths, identifying a link on the candidate path having a minimum remaining bandwidth,

and determining whether the minimum remaining bandwidth is not smaller than a predetermined value.

49. (Previously Presented) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a relay control section for selecting at least one relay server and a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and instructing said at least one relay server about data to be relayed, the relay control section selecting the path by identifying candidate path having a maximum remaining bandwidth of a plurality of paths, identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

a path setting section for requesting at least one path-settable router to set the path selected by the relay control section.

50. (Original) The network system according to claim 22, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

51. (Previously Presented) The network system according to claim 50, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay

servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

52. (Original) The network system according to claim 23, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

53. (Previously Presented) The network system according to claim 52, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

54. (Original) The network system according to claim 24, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

55. (Previously Presented) The network system according to claim 54, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

56. (Original) The network system according to claim 25, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

57. (Previously Presented) The network system according to claim 56, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

58. (Original) The network system according to claim 26, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

59. (Previously Presented) The network system according to claim 58, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

60. (Original) The network system according to claim 27, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

61. (Previously Presented) The network system according to claim 60, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved, the data is transferred to downstream from the congestion portion.

62. (Previously Presented) A network system including a plurality of routers and at least one cache server, said at least one cache server comprising:

- a network monitor for monitoring a network to obtain QoS path information including network path information and path load information;
- a path calculator for calculating a path for use in a cache control operation that is at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, wherein the path calculator identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and
- a controller for performing said cache control operation through the path calculated by the path calculator.

63. (Original) The network system according to claim 62, wherein the controller comprises:

- a relay controller for selecting at least one router as a relay router from the routers depending on the path calculated by the path calculator.

64. (Original) The network system according to claim 62, wherein said at least one cache server further comprises:

- a priority controller for providing a first priority to a packet for use in a communication associated with the cache control operation, wherein the first priority is lower than a second priority provided to a communication associated with an ordinary operation of said at least one cache server.